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REDUCTIONS IN SELF-INJURY PRODUCED BY TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION

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Transcutaneous electrical nerve stimulation is used to reduce pain but also may be useful for self-injurious behavior (SIB). In the current investigation, a microcurrent electromedical device, classified as a transcutaneous electrical nerve stimulator (TENS), was applied with a man with Down syndrome who displayed SIB that persisted in the absence of social contingencies. Although clinically significant results were not maintained, a clear difference in the rates of SIB during active and inactive TENS was observed.

DESCRIPTORS: automatic reinforcement, self-injurious behavior, transcutaneous electrical nerve stimulation

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Transcutaneous electrical nerve stimulation (TENS) is a method of electrotherapy used for the treatment of chronic pain and has been used to attenuate lower back pain, arthritis, carpal tunnel syndrome, phantom limb pain (Thompson, 1995), intractable pain (Cassuto, Liss, & Bennett, 1993), and pain associated with childbirth (Wall, 1985). TENS is hypothesized to produce an analgesic effect either by (a) flooding nerve fibers with electrical stimulation and interrupting the transmission of sensory input associated with pain (Melzack & Wall, 1965) or (b) stimulating the release of endogenous opiates (Sjolund & Eriksson, 1979). If either of these hypothesized mechanisms is correct, TENS may have potential as a treatment for self-injurious behavior (SIB). It has been proposed that SIB may sometimes be maintained by automatic reinforcement in the form of sensory stimulation or the release of endogenous opiates (Vollmer, 1994). TENS could potentially reduce automatically reinforced SIB by interrupting the transmission of sensory stimulation (i.e., extinction) or through noncontingent release of endogenous opiates (i.e., noncontingent reinforcement). In the current investigation, we conducted an analysis of the effects of TENS on severe SIB that did not yield clinically successful outcomes but showed clear effects on SIB with a young man with Down syndrome whose SIB was maintained in the absence of social contingencies.

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METHOD

Max was a 25-year-old man who had been diagnosed with profound mental retardation and Down syndrome and had been admitted to an inpatient unit specializing in the assessment and treatment of severe problem behavior. He displayed multiple forms of SIB, which resulted in contusions, lacerations, and auricular hematomas ("cauliflower ears"). Max's SIB produced frequent tissue damage even though he routinely wore arm splints, protective gloves, a helmet, or some combination during waking hours and a restraint blanket at night.

A functional analysis was conducted using methods similar to those developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), except that an ignore condition was conducted in place of an alone condition so that severe SIB could be blocked if that became necessary (which it did not). The results of the functional analysis showed that Max's SIB was highest in the ignore condition, suggesting that self-injury was maintained by automatic reinforcement. Previous treatments based in part on the results of the functional analysis included noncontingent access to visual and auditory stimulation, differential reinforcement of incompatible behavior, contingent water mist, restraint fading, and drug trials (naltrexone, carbamazapine, and clomipramine).

During all sessions, data collectors recorded the frequency of SIB (defined as eye poking, head punching, skin pinching, scratching, and head banging). All sessions were 10 min in length, except during Sessions 22 to 26 when sessions lasted 20 or 30 min, as indicated. Two independent observers scored SIB during 39% and 70% of sessions in the functional analysis and TENS assessment, respectively. Interobserver agreement was assessed for occurrence and nonoccurrence agreement by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Mean occurrence agreement was 80.7% and 90.9% for the functional analysis and TENS assessment, respectively. Mean nonoccurrence agreement was 87.7% and 92.4% for the functional analysis and TENS assessment, respectively.

The effects of TENS were evaluated in a multielement analysis in which the treatment, or active TENS condition, was compared to a control condition, or inactive TENS. The analysis was conducted over a 2.5-week period, and two to five sessions were conducted per day with a minimum of 1 hr between sessions. Data collectors were kept blind regarding when the TENS device was activated or deactivated. Prior to the start of each session, the TENS electrodes were placed on Max's earlobes, a padded helmet was placed on his head, and his arm splints were removed. Electrodes are most frequently placed around the area of pain. The earlobe was chosen as a stimulation site for Max because it was close to the areas of his head in which SIB typically occurred with minimal possibility of the device falling off. During active TENS sessions, the peak current of this square-shaped, continuously alternating current stimulation was set at 2 mA (zero to peak) and 4 mA (peak to peak). The device was set to a frequency of 100 Hz, yielding a phase duration of 5 ms. During inactive TENS sessions, Max wore the device but it was turned off. During all sessions, Max was seated at a table in a treatment room (3 m by 3 m). Preferred toys and objects were positioned in front of Max on the table, and he had free access to the items throughout the session. During the session, the therapist insured that the electrodes remained on Max's ears and readjusted them as needed.

Even with the padded helmet on, Max's SIB periodically produced significant tissue damage (e.g., bleeding, swelling, excessive redness). When this occurred, the medical

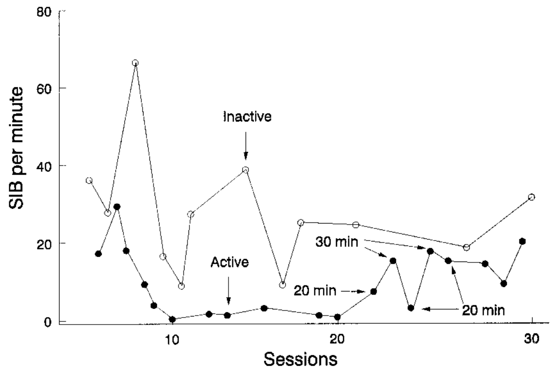

Figure 1. The number of self-injurious behaviors (SIB) per minute during TENS active and TENS inactive sessions.

staff instructed the therapist to block SIB directed at the affected area; however, Max remained free to direct his SIB to many other locations on his body. Otherwise, the therapist provided no differential consequences for SIB or other responses.

After we observed an effect for TENS during 10-min sessions, we attempted to determine whether this effect would be maintained during longer sessions. Therefore, later in the analysis, some sessions lasted either 20 or 30 min.

RESULTS AND DISCUSSION

The mean percentages of intervals of SIB during the functional analysis were (a) ignore, 42.2%; (b) social attention, 29.9%; (c) demand, 23.7%; and (d) toy play, 17.2%. These results suggested that Max's SIB was maintained by automatic reinforcement.

The effects of the active and inactive TENS are shown in Figure 1. SIB was maintained at high levels when the TENS device was inactive (M = 24.7 per minute for the last six sessions prior to increasing session length; range, 9.2 to 38.9). By contrast, SIB decreased markedly when the device was activated (M = 1.5 per minute for the last six sessions prior to increasing session length; range, 0.4 to 3.2). SIB increased in the active TENS condition when the session durations were 20 min (M = 8.3 per minute; range, 3.1 to 14.9) and 30 min (M = 16.5 per minute; range, 15.1 to 17.8). When the inactive versus active TENS conditions were repeated with 10-min sessions, active TENS again yielded lower SIB rates than TENS inactive, but the differences were less dramatic (Ms = 14.7 per minute for active TENS and 25.2 per minute for inactive TENS).

Because SIB increased when longer sessions were introduced, we examined the within-session trends for Sessions 15 through 26 to determine whether SIB was lower during the initial portion of each session (e.g., the first 10 min of a 20-min session) than during the latter portion. However, during the 20- and 30-min TENS active sessions, fairly steady rates of responding were observed over the course of each session except Session 24 (in which the rates increased toward the end of the session). Thus, the observed increase in SIB rates was *not* a function of increased session length; TENS appeared to lose efficacy for unknown reasons at about Session 22. However, the data paths for TENS active and TENS inactive never overlapped, showing that TENS active produced effects throughout the analysis relative to the control condition.

The current results provide some preliminary evidence for the potential application of TENS to SIB that is hypothesized to be maintained by automatic reinforcement in the form of (a) sensory stimulation or (b) a release of endogenous opiates. Future research should evaluate the effects of TENS with more individuals to determine whether its effects are specific to SIB that is maintained by automatic reinforcement. If so, studies designed to determine why TENS could have an effect on SIB would be warranted. That is, TENS may reduce SIB by interrupting the transmission of sensory stimulation (i.e., extinction) or through the noncontingent release of endogenous opiates (i.e., noncontingent reinforcement, which should reduce motivation). In the current investigation, TENS reduced SIB relative to the baseline condition (TENS inactive). Unfortunately, the dramatic effects of TENS diminished when longer sessions were conducted, and the initial effects were not recaptured when the active versus inactive TENS phase was repeated with 10-min sessions. If this is a reliable finding, future investigations should evaluate why the effects of TENS wane and, subsequently, how those factors responsible for reduced efficacy of TENS can be controlled.

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